
Kennedy Tunnel | Santiago Centro Oriente 2 Program | Chile | COSTANERA NORTE
Subterra

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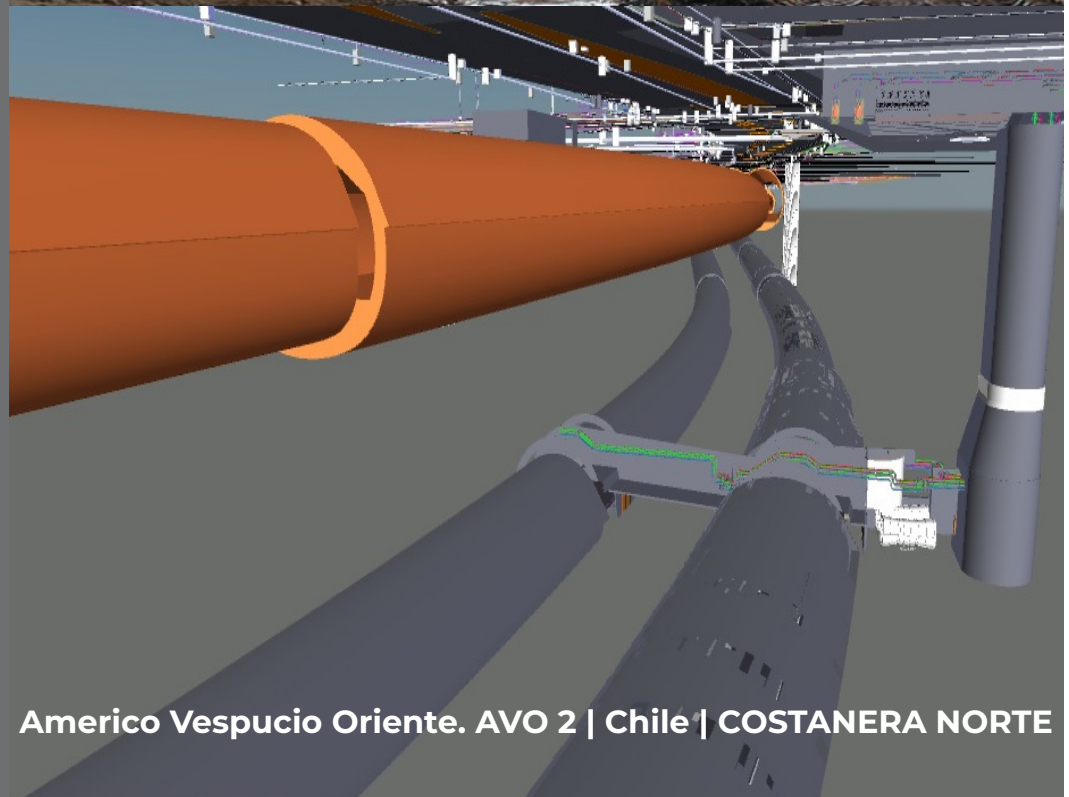
Alto Maipo Hydroelectric Project | Chile | HOCHTIEF-CMC

Company Overview

1. Introduction
2. Mission, vision, values
3. Staff
4. Software tools and facilities
5. Integrated Management System
6. Presence in organizations

Las Cruces Mine | Spain | COBRE LAS CRUCES

Americo Vespucio Oriente. AVO 1 | Chile | CVO



Americo Vespucio Oriente. AVO 2 | Chile | COSTANERA NORTE

1. Introduction

SUBTERRA is a private group, that offers consulting and engineering services for tunnels and underground works.

These services are provided seeking technical excellence, with the highest safety conditions, respect for the environment and social commitment; being certified in the management systems ISO 9001, 14001, 45001, 37001 and 166002.

SUBTERRA group actually is constituted by the following companies:

- **SUBTERRA Ingeniería Ltda in Chile,**
- **SUBTERRA Ingeniería SAS in Colombia,**
- **SUBTERRA Ingeniería SL in Spain,**
- **SUBTERRA Engineering Pvt. Ltd India, and**
- **SUBTERRA Ingeniería SAC in Peru;**

that functionally act as a unique company organizing its staff and facilities to offer the best services accordingly to the specific characteristics of each project.

During design engineering, our services include the acquisition and interpretation of geological-geotechnical data, sophisticated support and lining calculations, and the functional and safety installation design; all this applied to all phases from feasibility, basic engineering, to value and detail engineering. In the construction phase, our services include supervision, auditing and technical advice.

We have offices in Bogotá, Delhi, Lima, Madrid, Medellín and Santiago, all equipped with specific software tools such as FLAC 2D and 3D, UDEC, PFC, EXAMINE 2D and 3D, SAP2000, FAGUS, STEPS, SOLVENT, etc.

We form a highly specialized multidisciplinary team from eight countries in Latin America and India that, to date, has developed projects in more than 35 countries.

SUBTERRA has established itself worldwide as one of the leading engineering companies specializing in the field of underground works.

Interoceanic South. Ollachea Tunnel | Peru | INTERSUR

2. Mission, vision, values

Mission

To provide geotechnical, tunnelling and underground space engineering services based on a rigorous analysis of each case, in order to develop technical solutions optimizing the construction costs with the maximum safe and environmental conditions, as well as compromise with the community.

Vision

To be a benchmark in the Iberoamerican and India geotechnical, tunnelling and underground space engineering.

Values

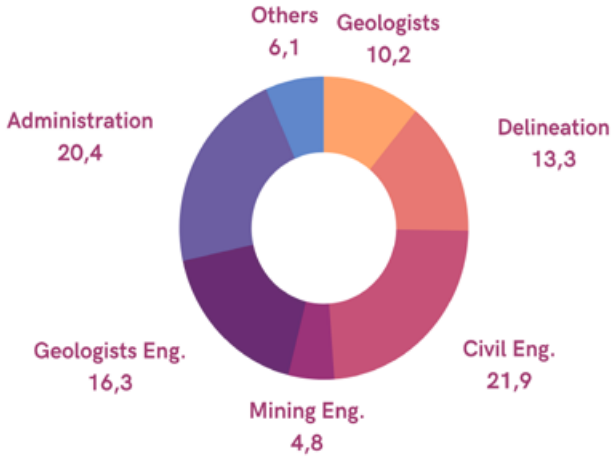
- **Excellence:** through quality and continuous improvement, providing optimal solutions from a technical, environmental and health and safety point of view.
- **Innovation:** applying technologically advanced solutions, learned through applied research and shared with the technical community.
- **Social commitment:** with the community to improve the well-being of people where we are present.
- **Motivation:** our team, the best capital at your service, has a passion for the land and learns from its mistakes and its successes. We believe in what we do.
- **Integrity:** our honesty and independence are a guarantee of the success of our technical solutions.

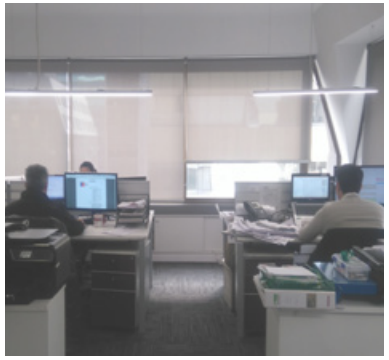
3. Staff

Having the best professionals allows us to increase our **productivity** and seek **excellence** in our work. For this reason, we currently offer a highly qualified **multidisciplinary** team, made up of people from nine countries (Argentina, Bolivia, Chile, Colombia, Guatemala, Spain, India, Peru and Venezuela).

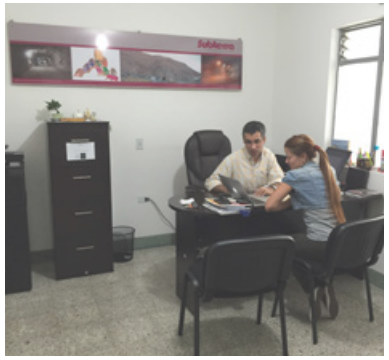
To offer the best services, there is a continuous training plan for our professionals and we strive to **attract and retain talent**.

We have an **equality plan at work**, which means that 40% of our workforce is made up of highly qualified women.



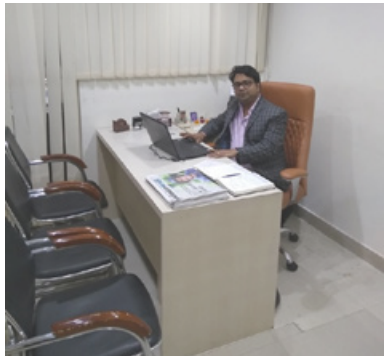


Santiago | Chile

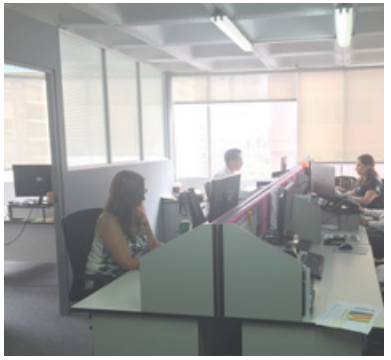


Medellín | Colombia

Madrid | Spain



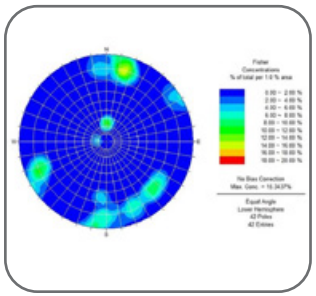
Delhi | India

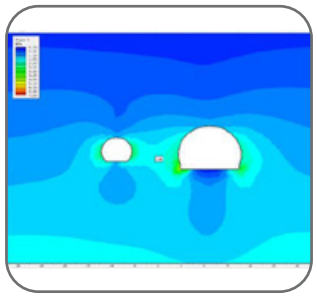


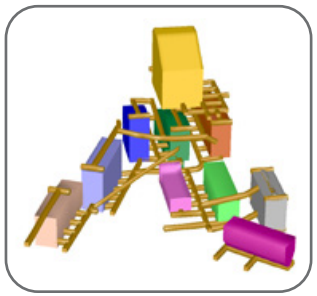
Lima | Peru

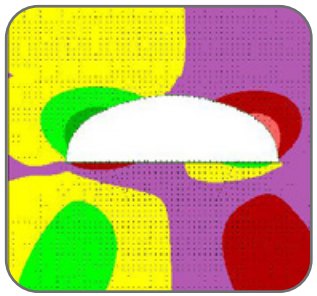
4. Software tools and facilities

Our offices in Santiago (Chile), Medellín (Colombia), Madrid (Spain), Delhi (India) and Lima (Peru), are equipped with **advanced software** to offer **optimized solutions.**


DIPS V.5.1


EXAMINE 2D V.7.0


EXAMINE 3D V.4.0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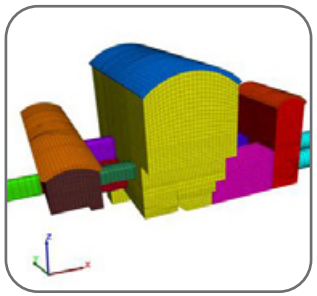
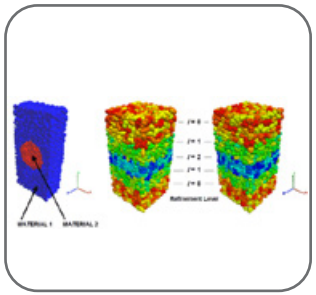
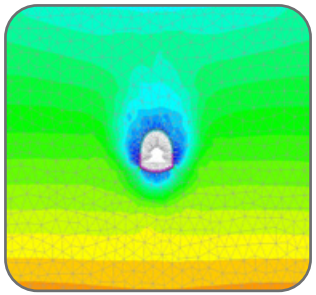
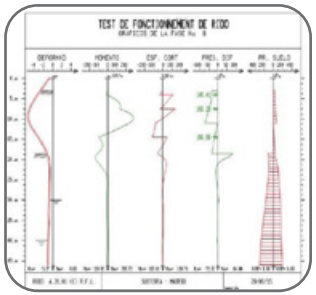

FLAC 3D V.5.0


PFC2D V.4.0


PHASE 2 V.8.0



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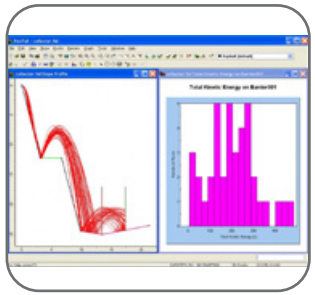
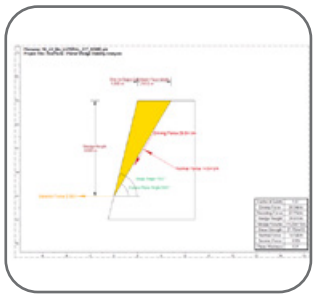
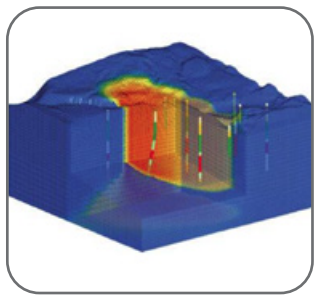

ROCFALL V.4.0


ROCPLANE V.6.0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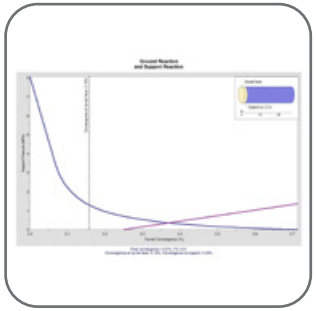
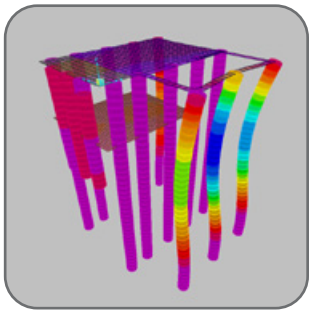
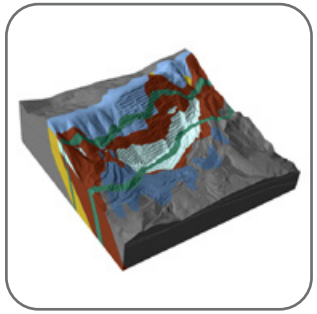
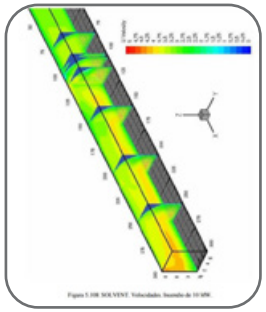
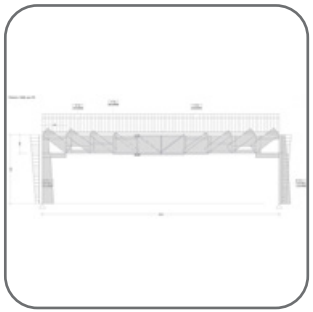

ROCSUPPORT V.3.0

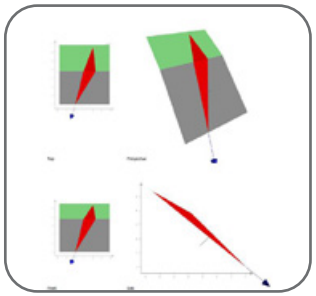

SAP2000


SLIDE 3D V.3.0


SOLVENT V.IV


STATIK V.6.0


STEPS V.5.3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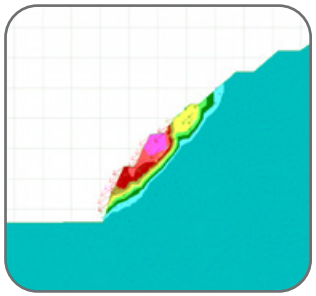
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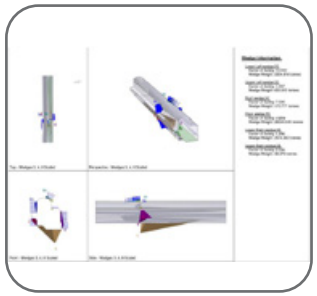
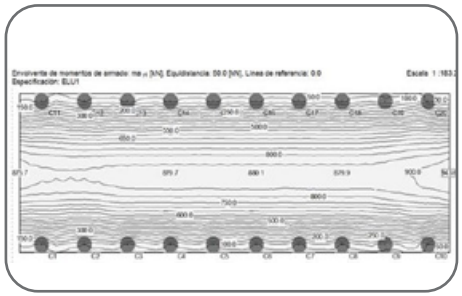
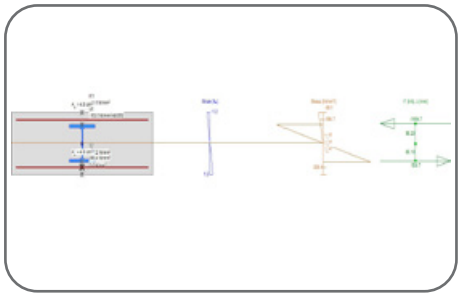

UNWEDGE V.3.0


CEDRUS V.6.0


FAGUS V.6.0

5. Integrated Management System

SUBTERRA's **Integrated Management System** pursues the objective of prioritizing and standardizing efforts, to offer our clients the **highest quality,** with the **most innovative methodologies**, without forgetting to contribute to **sustainable development**, and maintaining the most demanding standards in terms of **safety**.

Currently the SUBTERRA SIG is certified in the standards: ISO 9001 (Quality), ISO 14001 (Environment), ISO 45001 (Prevention of Occupational Risks), ISO 37001 (Anti-bribery) and UNE 166002:2014 (Management of R+D+i).

ISO 9001 BUREAU VERITAS Certification

ISO 14001 BUREAU VERITAS Certification

ISO 45001 BUREAU VERITAS Certification

UNE-EN 166002 BUREAU VERITAS Certification

ISO 37001 CERTIFIED GLOBAL CERTIFICATION BUREAU

False Tunnel Almendral | Spain | OSSA-TAPUSA

6. Presence in organizations

SUBTERRA participates in the following associations:

- AIC (Asociación de Empresas Consultoras de Ingeniería de Chile A.G.)
- AMINER (Asociación de Empresas Investigadoras, Extractoras, Transformadoras Minero-Metalúrgicas, Auxiliares y de Servicios)
- CÁMARA DE COMERCIO DE CANADÁ
- EURACOAL (European Association for Coal and Lignite)
- PTES (Plataforma Tecnológica Española de Construcción)
- PTTP (Plataforma Tecnológica de Túneles)
- SEMR (Sociedad Española de Mécanica de Rocas)
- TECNIBERIA (Asociación Española de Empresas de Ingeniería, Consultoría y Servicios Tecnológicos)
- ACTOS (Asociación Colombiana de Túneles y Obras Subterráneas)
- AETOS (Asociación Española de Túneles y Obras Subterráneas)
- APTOS (Asociación Peruana de Túneles y Obras Subterráneas)
- CTES (Comité de Túneles y Espacios Subterráneos de Chile)

At the same time its members belong, or have belonged to the following organizations:

- AENOR: Comité CTN 103 “Geotecnia”.
- ATC: Comité de túneles de la Asociación Técnica de Carretera
- ASTM: Comité D18.02.07. Ensayos de presiometría y dilatometría.
- COMISIÓN EUROPEA: Coal Advisory Group (TGC1-DGXII)
- COMITÉ EUROPEO DE NORMALIZACIÓN CETN TG 341 WG5: Geotecnia.
- CORDIS (Comm. Research and Development Information Services): FP7.

SUBTERRA has personnel affi liated to the following Professional Associations:

- CHILE: Colegio de Ingenieros de Chile A.G.
- COLOMBIA: Consejo Profesional Nacional de Ingeniería
  Sociedad Antioqueña de Ingenieros y Arquitectos
  Sociedad Colombiana de Ingenieros
- SPAIN: Colegio Oficial de Ingenieros de Minas
  Colegio de Ingenieros de Caminos, Canales y Puertos
  Colegio Oficial de Geólogos
- PERU: Colegio de Ingenieros del Perú

Hydroelectric power station Belesar II | Spain | GNF Engineering

La Quiebra Tunnel. Concesión Vial del Nus | COLOMBIA | MINCIVIL

Company activities

7. Professional capabilities
8. R+D+i activities
9. Safety installations
10. Diagnosis and rehabilitation of tunnels

Guadalajara Metro | Mexico | MOTA ENGIL-SACYR

Leaders of the tunnel consultancy sector in Latin America

7. Professional capabilities

Tunnels and underground excavations

- Construction Process Analysis
- Tunnel Boring Machines (TBM)
- Support and Lining Design
- Subsidence Evaluation
- Portals
- False tunnels (C&C screens, ...)
- Caverns and Shafts
- Geotechical Assessment during Construction
- Monitoring Programs
- Diagnosis and Rehabilitation of Tunnels
- Safety Installations (Ventilation, Ilumination, etc)

Mining

- 3D Geological Modeling
- Mine Feasiblity Studies
- Open Pit Designs
- Rehabilitation of Mining Spaces
- Undergroung Mining Designs
- Mine Decommissioning and Closure
- Mining tailings deposit
- Underground Mine Infraestructure Design (Tunnels, Shafts & Caverns)

Geotechnical

- Hazard and Geological Risk Study
- Hidrogeology Studies
- Soil & Rock Mechanics
- Study of Slopes of Clearing
- Studies of Embankments, Pedraplenes and Dumps

8. R+D+i activities

The applied research give us the opportunity to off er our clients the latest ground engineering techniques, improving our designs, enabling them to solve these complexes and challenging problems.

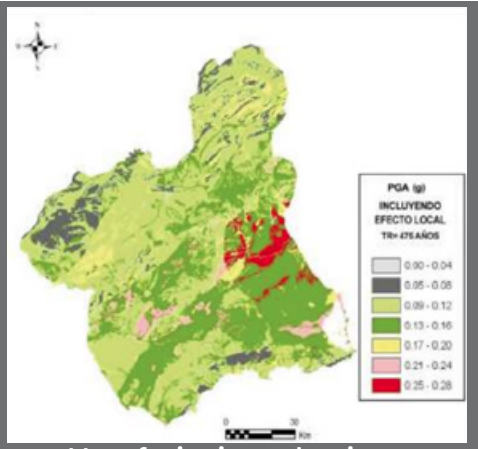
As we said before, we have a UNE 166002 system for the Research and Development projects. We were registered as an innovative PYME.

In the past we collaborated in the following projects of R+D+i:

- MODELRISK. INNPACTO SUBPROGRAM 2010-2014. Ministerio de Ciencia e Innovación. Spain.
- COGAR. RFC-PR-12005 – (2013-2016). European Comission. DG XII.
- SLOPES. RFCR-CT-2015-00001 – (2015-2018). European Comission. DG XII.
- TUÑEL. 2015-2018. Centro para el Desarrollo Tecnológico Industrial (CDTI) Spain.
- SYOS. 2017-2019. CONCYTEC. Perú.
- KNOWTUNNEL. 2017 - 2019. CDTI. Spain.

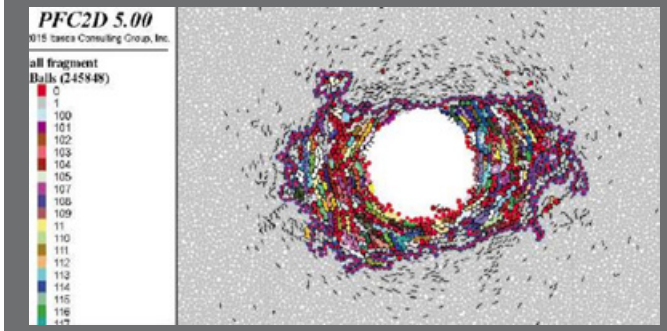
Currently we have the following projects:

- Risk Assessment of Final pits during Flooding (RAFF). 2019 - 2022. RFCS. European Comission. DG XII,
- The impact of EXtreme weather events on MINing operations (TEXMIN). 2019 - 2022. RFCS. European Comission DG XII,
- From Mining Waste to Valuable Resource: New Concepts for a Circular Economy (MINERESCUE). RFCS. 2020-2023. European Comission DG XII,
- A human-centred internet of things platform for the sustainable mine of the future (Dig_IT). 2020-2024 European Comission H2020.
- Tunnel Advance Predictive System(PREDICTUNEL). 2022-2023. CORFO Chile
- Tool for the management of geotechnical information and the design of support in tunnels through observational methods and advanced algorithms (HERSOS). 2022-2023. CONCYTEC Perú



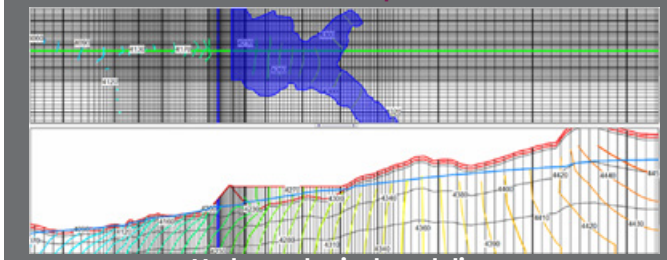
Map of seismic accelerations

MODELRISK | MINISTERIO DE CIENCIA E INNOVACIÓN



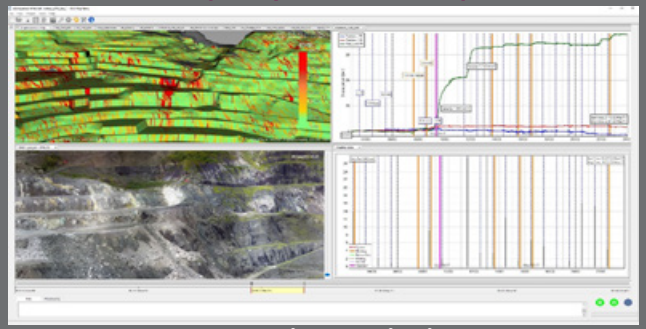
Thermal effect in a gasifi cation's borehole

COGAR |



Hydrogeological modeling

TEXMIN | European Comission | RFCS



Remote geotechnical monitoring systems

DIG_IT | European Comission H2020

9. Safety installations

Inside the engineering of tunnels and underground spaces, it is essential to have modern installation systems that enable their functionality in the maximum safety conditions.

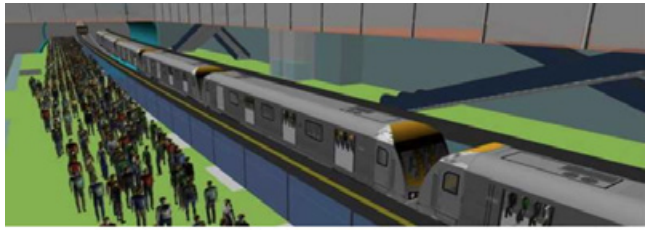
The regulations and recommendations are increasingly demanding in terms of safety and require a detailed analysis of the systems that tunnels require for satisfactory operation both during the operation phase and in the event of an emergency.

To this end, it is essential to carry out a security design focused on the following concepts:

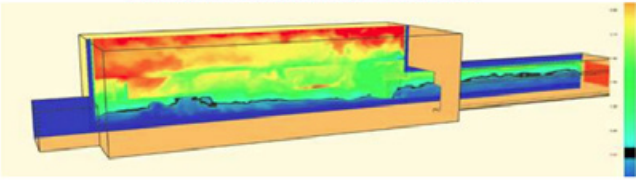
- **Ventilation system.**
- **Monitoring and control system.**
- **Lighting system.**
- **Signaling and means of evacuation.**
- **Systems of detection and extinction of fire**

To meet this demand, **SUBTERRA** offers the following services::

- **Safety installations project,** including ventilation, illumination and all electromechanical systems necessaries.
- **Tunnel inspections: including,** to verify correct compliance with regulations and advise on improvements or optimizations.
- **Ventilation tests and algorithms t**hat allow analyzing the correct operation of the ventilation system and being able to define the optimal operating sequence.
- **Emergency drill** in which exercises are carried out jointly with the EESS and their interaction with the tunnel is analysed.
- **Analysis of risks,** versus diff erent scenarios typifi ed in the regulations for cases of accident and fire.



Simulación de evacuación en estación de metro



Simulación de incendios en Estaciones

Ventilación Túnel AVO I

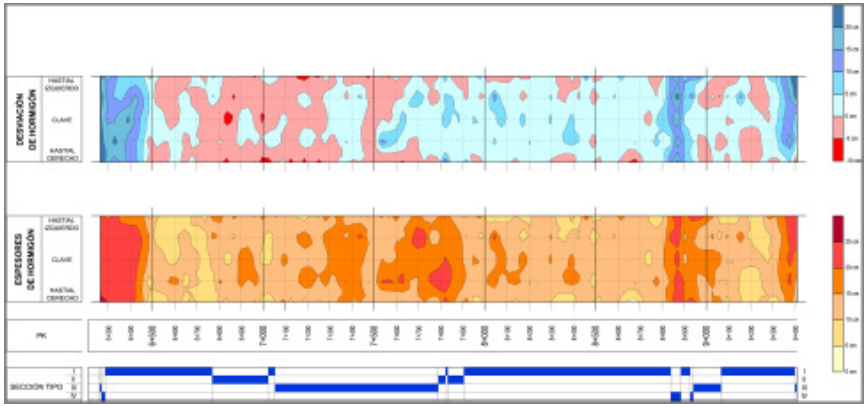
Main references of security installations projects

Project	Country	Function	Typology		Traffic	Length (m)	Level of study	Year
Américo Vespucio Oriente. El Salto-Príncipe de Gales (AVO 1)	Chile	Road	Single bore	3 tracks	Single way	8360	Final design	2014-16
Américo Vespucio Oriente. Príncipe de Gales-Los Presidentes (AVO 2)	Chile	Road	Double bore	3 tracks	Single way	2x5.200	Final design	2018-19
Túnel del Aeropuerto de Guayaquil	Ecuador	Road	Double bore	2 tracks	Single way	2x3.140	Final design	2016
LAV Galicia. Cerdedo-Barro. Túnel de Os Campos	Spain	Railway	Single bore	2 lanes	Double way	2795	Final design	2011
LAV Galicia. Cerdedo-Barro. Túnel de O Galo	Spain	Railway	Single bore	2 lanes	Double way	4705	Final design	2011
LAV Galicia. Cerdedo-Barro. Túnel de Barro	Spain	Railway	Single bore	2 lanes	Double way	7792	Final design	2011
Túnel 1 de la Autopista Agaete-La Aldea	Spain	Road	Double bore	2 tracks	Single way	2x3.100	Operating manual	2017
Tramo 4 FFCC Gran Canaria	Spain	Railway	Single bore	2 lanes	Double way	6430	Final design	2018
Carretera Amazoc-Veracruz. Túnel Xalpetec	Mexico	Road	Single bore	4 tracks	Double way	302	Final design	2009-10
Interoceánica Sur. Túnel Ollachea	Peru	Road	Single bore	2 tracks	Double way	1025	Final design	2017-18

10. Diagnosis and rehabilitation of tunnels

SUBTERRA offers a tunnel's inspection services, diagnosis and rehabilitation, based in its experience in the interaction's analysis between the ground, governed by its mechanical parameters and the characteristics of the support applied to the tunnel.

- **Inspection of Tunnels**
- **Structural Rehabilitation Tunnels Projects**
- **Maintenance Programs of Tunnels**



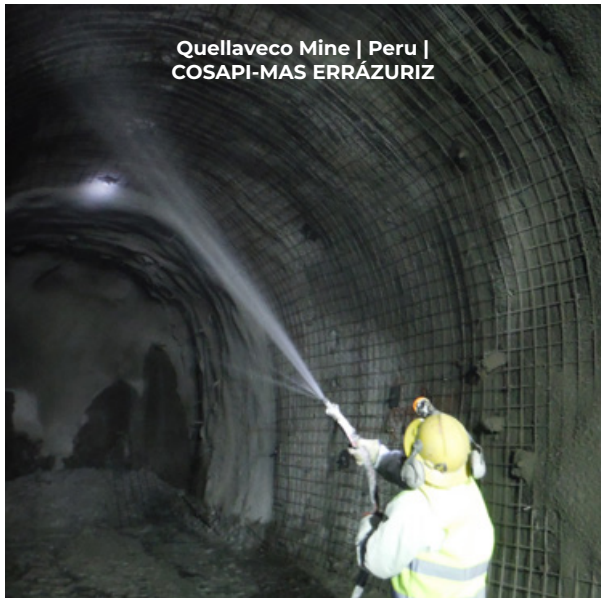
Thickness isolines of shotcrete.
La Aldea Tunnel | Spain | UTE LA ALDEA (OHL-TITO-FCC)

Main references

- Inspection and expert report of the underground warehouses. Navalcarnero (Spain) 2020
- Terminal tunnel maintenance. Colca-Sigüas System (Peru) 2018
- Inspection and verification, transport tunnel and By Pass tunnel. Antamina (Peru) 2017
- Astigarraga-Irún tunnels (Spain) 2017
- Inspection and verification. Hydroelectric power, Pangal tunnel (Chile) 2017
- Inspection tunnel. Quellaveco Mine (Peru) 2016-17
- Definition of stabilization solutions. San Lorentzo and Belabieta A-15 tunnels (Spain) 2016
- Tunnel 1 highway Agaete-La Aldea. Tunnel lining and drainage analysis (Spain) 2015
- Inspection and rehabilitation project of the adduction tunnel of Pizarras HP (Peru) 2013-14
- Inspection of the railway tunnels of Forcadiña, Sierra Pequena and El Molino (Spain) 2013
- Rehabilitation railway tunnels Llanes Bypass. Altares and El Bolao Tunnels (Spain) 2012
- Inspection and advice. Portillo CH La Confluencia Tunnel. VI Region (Chile) 2011-12
- Inspection of the tunnels of the Jabarrella Canal (Spain) 2010

Rehabilitation PH La Confluencia |Chile | HOCHTIEF-TECSA

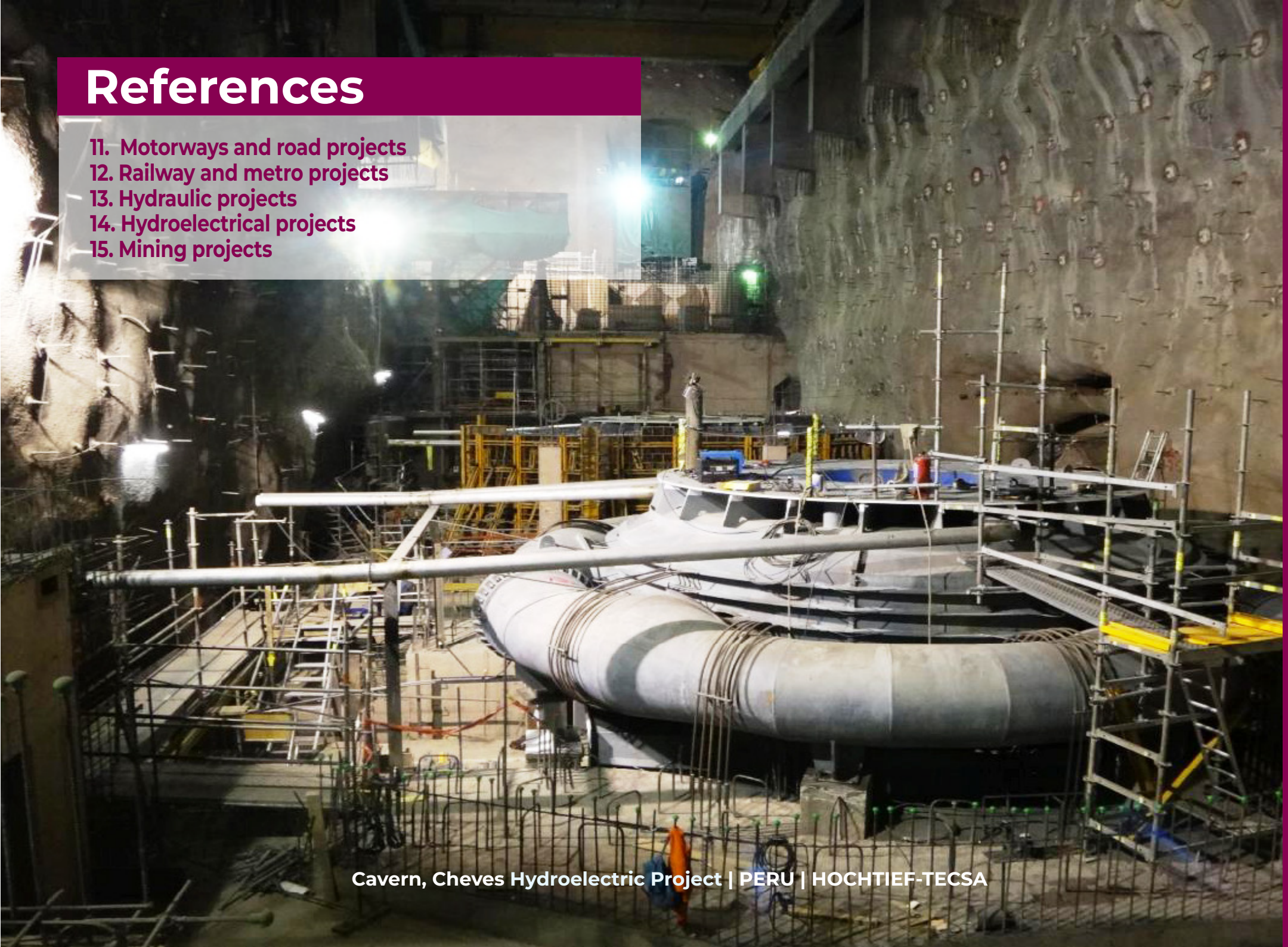
San Lorentzo and Belabieta Tunnels | Spain | DIPUTACIÓN FORAL DE GIPUZKOA



Quellaveco Mine | Peru | COSAPI-MAS ERRÁZURIZ

San Francisco Mines Hydroelectric Project | Ecuador | GNF ENGINEERING

References



Cavern, Cheves Hydroelectric Project | PERU | HOCHTIEF-TECSA

Americo Vespucio Oriente. El Salto-Príncipe de Gales, Chile

AVO 1 project has been divided into two sectors:

Sector 1: Avenida El Salto - Puente Centenario, between DM 0.000 and 3.368. It contemplates the execution of two separate platforms for each direction of traffic, which each house three tracks. In the North-South direction, the execution of a viaduct is projected that starts from the surroundings of the junction of the Business City and then continues through a three-lane tunnel under the San Cristóbal hill (La Pirámide tunnel) and under the Mapocho river. After the passage under the Mapocho there is a section in a simple covered trench, which begins to transform into a two-level trench. This two-level trench continues under Vespucio's tray until it connects with Sector 2.

Sector 2: Centennial Bridge - Prince of Wales Avenue, between DM 3,368 and 8,278. Both directions of circulation run inside a common underground structure with two levels of circulation, with 3 lanes each plus their corresponding additional lanes on the entrance and exit ramps. The South-North direction of circulation runs along level -1 of the covered trench, having as a starting point the access to the entrance hatch that is at the height of Carlos Alvarado street. The north-south direction of circulation runs through level -2, which has as its end point or exit the hatch that is at the height of Las Luciérnagas street. On the other hand, Sector 2 has as singular points the pass under Kennedy and under Apoquindo, in which there is a section that is built as a tunnel in mine projected according to the construction philosophy of the German Method.

Tunnel and geotechnical. Santiago Centro Oriente 2 Program, Chile

Costanera Norte has been appointed by MOP (Ministerio de Obras Públicas of Chile) to develop the new traffic system East-West in Santiago de Chile. Detailed design and technical adduce will be camed out by **SUBTERRA**.

Costanera Norte-Costanera Sur tunnel, 292 m long, 10 meters wide, will house two lanes of road traffic, it will be excavated in the Gravas del Mapocho, and in a rocky massif composed of shales and andesites.

Kennedy Tunnel, constitutes the most singular work of the involved in the Project, runs along its 1,150 meters in length parallel to Kennedy Avenue, on the north side of the Golf Club and between the current roundabout Perez Zujovic to the west of the intersection of the Avenues Kennedy and Américo Vespucio. The tunnel section will house a four-lane traffic platform which entails widths of excavation of around 20 meters and excavation sections of 200 m^2. The The excavation will be developed following the NATM and by dividing the section into different phases.

Lo Saldes Tunnel, 65 m long and 14 meters wide, excavation.

Project	Section (m^2)	Length (m)	Year	Country	Design engineering	TA.
Carretera Maitenes-Confluencia. Túneles T1, T2 y T3	75	447+989+3.361	2012-15	Chile	•	•
Programa Santiago Centro Oriente 1. Túnel Vivaceta	92	580	2013-14	Chile		•
Costanera Norte. Túnel AVO bajo Kennedy	284	42	2013	Chile	•	
Programa Sgo. Centro Oriente 2. Túneles: Costanera N.-Costanera S., Kennedy y Lo Saldes	80/200/900	292+1150+65	2013-17	Chile	•	•
Américo Vespucio Oriente. El Salto-Príncipe de Gales (AVO 1)	148	8.360	2014-20	Chile	•	•
Autopista Radial Nororiente. Túnel Chamisero 2	80	2x1.590	2015-17	Chile	•	•
Eje Los Maitenes. Parque Negocios Enea	85	282	2016	Chile	•	
Américo Vespucio Oriente. Príncipe de Gales-Los Presidentes (AVO 2)	93/120	2x5200+2x4.200+1390	2018-22	Chile	•	•
Trazado de la carretera LP-1. Tramo Las Tricias – Llano Negro	90	6.000	2021	Spain	•	
Cincunvalación de La Laguna. Tenerife	110	4.150	2021	Spain	•	
Asistencia Técnica de Supervisión de Proyectos Integrales de Madrid Calle 30	-	-	2021	Spain		•
Soterramiento A5. Madrid	301	3420	2021	Spain	•	
Carretera Central. Túnel de Yanango	100	1.062	2014-16	Peru		•
Estudio de viabilidad y definitivo variante Río Blanco - Huari	89/83/91	274+207+3213	2019-20	Peru	•	
Tramo 2 de IIRSA: Pte Ricardo Palma – La Oroya. Túnel Chacahuaro II	80	360+1.025+2007	2016-19	Peru	•	•
Estudio definitivo proyecto de construcción de la vía de evitamiento La Oroya	113	1200	2019	Peru	•	
Túnel de Chancay. Terminal portuaria.	99	1.810	2020-21	Peru	•	•
Túnel Ollachea. Interoceánica Sur	80	1.025	2020-21	Peru	•	•
Autopista Tharthri-Kilhotran. Túnel de Kahaljugasar	79	2x4.000	2018-19	India	•	
Carretera Monteagudo -Ipati. Túnel de Incahuasi	72	1.230	2010-11	Bolivia	•	
Rodoanel Trecho Norte. Túnel 501	180	2x1.100	2014-16	Brasil		•
Autopista Guayaquil – Santa Elena. Túnel de Santa Elena	92	2x3.000	2014	Ecuador	•	
Túnel del Aeropuerto de Guayaquil	110	2x3.140	2016	Ecuador	•	
Carretera Amazoc-Veracruz. Túnel de Xalpetec	145	302	2009-10	Mexico	•	
Libramiento Acapulco. Túnel María Bonita	210	495	2015	Mexico	•	
Autopista Jala-Las Varas. Túneles de Las Truchas y Paso del Jaguar	190	240+235+120	2017-18	Mexico		•
Autopista Atizapán-Atlacomulco. Túneles de Los Gallos y Cahuacán	215	210+115	2018-19	Mexico		•
Autopista Jala-Las Varas. Túnel Guamúchil	144	1.080	2019-20	Mexico		•
Autopista Mitla - Tehuantepec: Túnel 3. Oaxaca	119	1.735	2021	Mexico	•	
Autopista Atizapán de Zaragoza – Atlacomulco: Túneles Cahuacán y Los Gallos	215	115+208	2021	Mexico	•	

El Corno tunnel. Lubián-Orense High Speed Line, Spain

El Corno tunnel, designed on the Cerdedelo-Porto Lubián - Ourense High Speed Line section, is a twin tube tunnel which has a lenght of 8.5 km.

The tunnel alignment crosses at several points the current route of the railway line, which is an important milestone to consider when analyzing the stability of the tunnel.

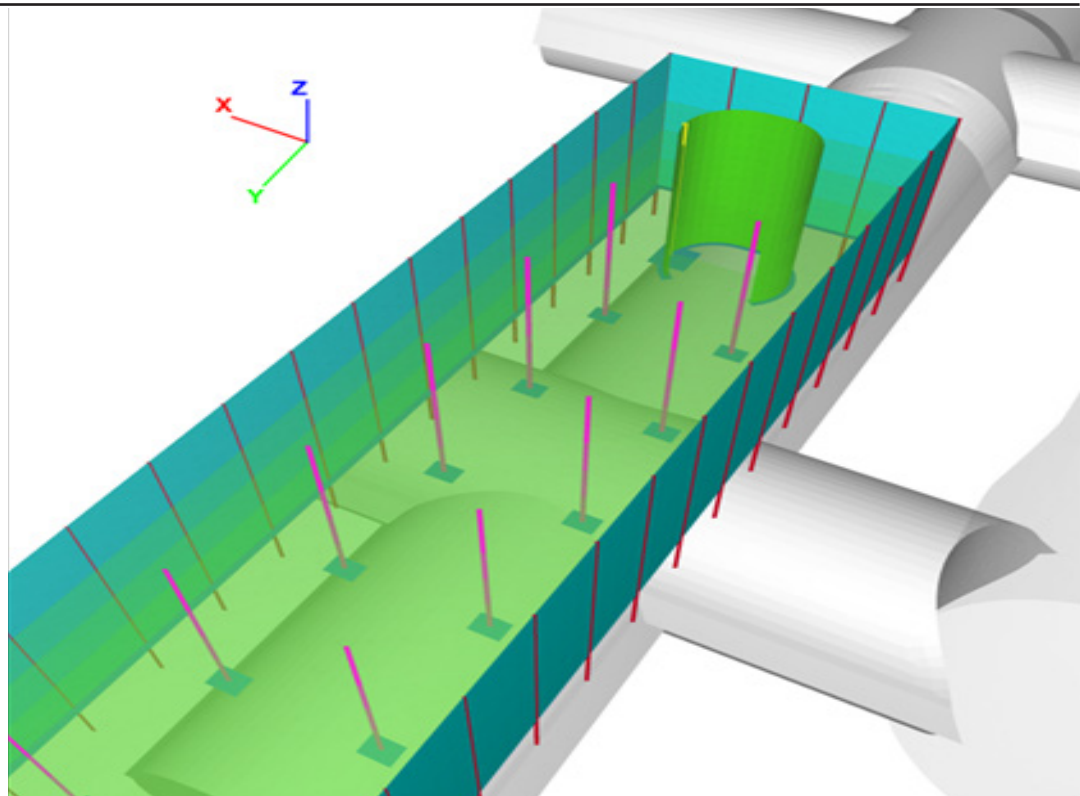
It is designed to an Adit of nearly 800 m in order to carry out the excavation of the tunnel Corno from four diferentes faces.

In addition it is designed the junction between the tunnel and the Adit in an area where the water infi ltration to the excavation is high.

Line 7 of the Santiago Metro. Section B, Chile

Detailed Engineering of the Shafts, both for Stations and for Construction, Galleries and **Tunnels of Line 7**, for section B, whose western limit is constituted by the eastern tympanum of Walter Martínez Station, and PK 18 to the east +100, covering an approximate length of 10,400 km, including in said section: six stations (Matucana, Cumming, Cal y Canto, Baquedano, Pedro de Valdivia and Isidora Goyenechea), eight Construction Shafts and three Ventilations.

It also includes the Detailed Engineering of the extension of the Line 6 Interstation Tunnel, from the current maneuvering queue to the PC-13 shaft, including the Station Tunnel of the future Isidora Goyenechea Station of that Line.



Project	Section (m^2)	Length (m)	Year	Country	Design engineering	TA.
Asesoría especializada en TBM. Tramo 1. Línea 7 de Metro	120	7.500	2019	Chile		•
Metro Santiago de Chile. Tramo B. Línea 7	75/170	10.400 (km)	2019	Chile	•	•
LAV Burgos-Vitoria. Burgos-Prádanos de Bureba. Túnel de Fresno de Rodilla	77	5.250	2009-10	Spain	•	
Tren Sur. San Miguel-Arona. Túnel 6	115	2.283	2010	Spain	•	
Eje Atlántico de Alta Velocidad. Tramo: Vigo-O Porriño	115/77	10.000	2010	Spain	•	
FFCC Manacor-Artá. Tramo Son Servera-Artá. Túnel de Son Sureda	40	80	2010	Spain	•	
LAV Bobadilla-Granada. Archidona-A. de la Negra. Túnel Archidona	138	1.053	2010	Spain		•
Tren de Gran Canaria. El Goro-Aeropuerto. Túnel de El Goro	105	2.000-4.300	2011-12	Spain	•	
Tren de Gran Canaria. Maspalomas-Maspalomas. Túnel Maspalomas	100	3.000	2011	Spain	•	
LAV Galicia. O Carballiño-O Irixo. Túneles 1, 2 y 3	78/110	2400+2271+2278	2011	Spain	•	
LAV Galicia. Cerdedo-Barro. Túneles de Os Campos, O Galo y Barro	71/110	2795+4705+7792	2011	Spain	•	
LAV Asturias. Pola de Lena-Oviedo. Túnel de Pola de Lena	118	11.380	2012	Spain	•	
LAV Madrid-Galicia. Prado-Porto. Túnel de Prado	72	7.606	2012	Spain	•	
LAV Madrid-Galicia. Cerdedelo-Prado. Túnel del Corno	72	8.510	2011-16	Spain	•	•
Metro San Sebastián. Estación de La Concha	150	190	2016	Spain	•	
Proyecto constructivo de la variante Sur Ferroviaria de Bilbao.	90	7.526	2021	Spain	•	
Renovación integral de los Túneles del Padrún (83I) y Túneles de Villabona (90I Y 90II).	35	2637+901+856	2021-22	Spain	•	
APD Tramo 2. Túneles 1, 1A2 y 2	52/75	600+18900+3680	2013-15	Argelia	•	
FFCC Obulavaripalle-Venkatachalam. Túnel de Chennai	52	980+6.780	2010	India	•	
Anteproyecto avanzado Metro de Dublín	115	2.339.23+8909	2019	Irlanda	•	
Línea 3 Metro de Guadalajara	120	4.500	2015-17	Mexico	•	•
Ho Chi Minh City Urban Mass Rapid Transit Line 2	65	9100	2018	Vietnam	•	

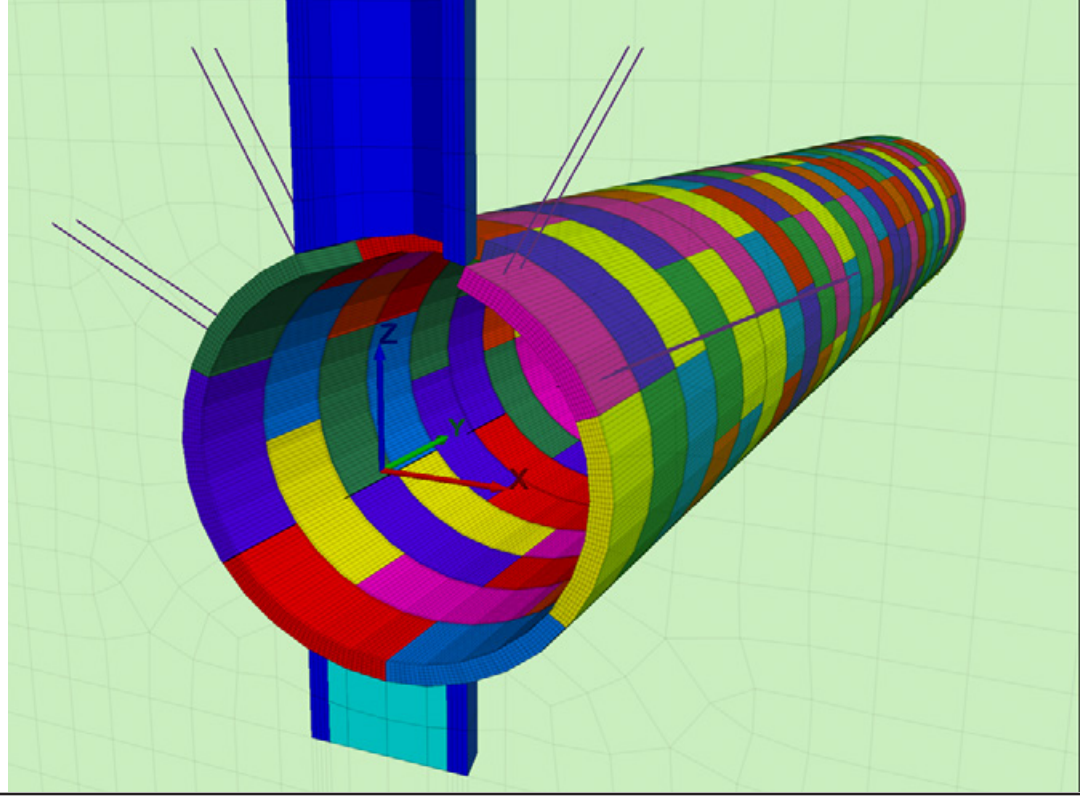
Detailed engineering of the drainage system in Pozuelo de Alarcón, Spain

In order to be carried the rainwater to the new urban areas, the Pozuelo de Alarcón's sewer has been designed underground. For it **SUBTERRA** proposed the construction of a **tunnel of 4,543 m length**.

It was realized a detailed analysis of the stability of the front of the excavation by TBM and the link of the precast concrete segments.

In addition, it was designed a unique connection between the sewer, the Adit, and the ventilation duct.

The lithologies aff ected by the Pozuelo's sewer belong to the so-called "Material detrítico de Madrid" (clays and sands).

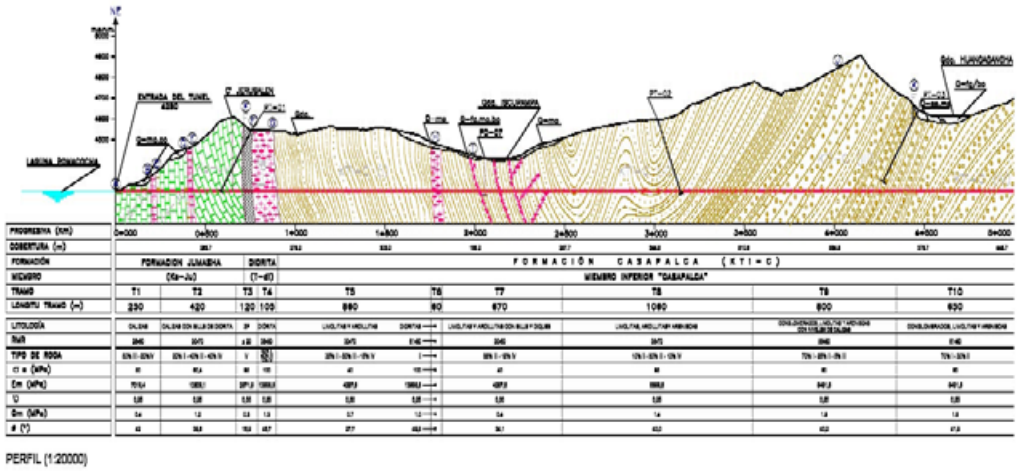


Desalination plant for the Atacama Region, Copiapó, Caldera, Chañaral and Tierra Amarilla, Chile

ECONSSA S.A. is developing the Project "Desalination Plant for the Atacama Region", for the supply of drinking water to the towns of Copiapó, Caldera, Chañaral and Tierra Amarilla.

The complete project consists of obtaining seawater by means of an open capture in depth and its sending to the desalination plant for desalination, the production of water suitable for human consumption in the desalination plant, its storage in a product water pond and the distribution of the water drinkable through impulses and lifting stations, to the different points of supply of the population for the localities of Caldera, Chañaral and Recinto de Piedra Colgada, the latter for supply the towns of Copiapó and Tierra Amarilla. In addition, it includes the discharge of the brine to the sea and the electrical supply to the different points of consumption. Among the works to be carried out, the construction of the following underground works is planned: Pique Inmisario / Pique Emisario.

Project	Section (m^2)	Length (m)	Year	Country	Design engineering	TA.
Embalse de Chironta	70	473	2018	Chile		•
Planta desalinizadora Región de Atacama, Copiapó, Caldera, Chañaral y Tierra Amarilla	14	25	2017-18	Chile	•	
Nueva línea de aducción PTAR río Cali	9	1.630	2019	Colombia	•	
Colector-interceptor de Pozuelo de Alarcón	6,5	4.572	2010	Spain	•	
EDAR Sinova	10,2	4.960	2021-22	Spain	•	•
Trasvase Majes - Siguas. Túneles Transandino y Pucara	25	11.410+6.450	2011	Peru	•	•
Derivación Llucla-Siguas. Túneles 1, 2 y 3	25	4600+2500+3100	2012-14	Peru	•	
Abastecimiento Agua Potable a Lima. Túnel de cabecera	15	9898	2014-15	Peru	•	



Basic engineering. Drinking water supply works to Lima | PERU | PROINVERSIÓN

New adduction line residual water treatment plant Cali river | COLOMBIA | OHL

Alto Maipo hydroelectric project, Chile

Alto Maipo Hydroelectric Project (PHAM) is located in the commune of San José de Maipo, Cordillera Province, Santiago Metropolitan Region, Chile.

The underground works included in the PHAM are:

6,250 m long **"Alfalfal II"** tunnel, of which the initial 3,250 m will be built with D + B in a box section of 4.75 x 4.90 m (20.8 m^2), and the rest with TBM of about 4.10 m in diameter (13.2 m^2),

1,020 m long **"Suelo"** tunnel to be fully excavated using conventional methods, with a 4.0 x 4.0 m trunk section (13 m^2),

"El Volcán" tunnel, 14,100 m long, of which 7,100 m will be built with D + B in a trunk section of 3.80 x 4.90 (4.60) m (17/16 m^2), and the rest with 4.10 m diameter TBM (13.2 m^2).

Also it is included the geotechnical monitoring of all underground works of the hydroelectric project.

Cheves hydroelectric project, Peru

Cheves hydroelectric project is located located on the Huaura River, between the towns of Sayán and Churín (Peru). This The hydroelectric plant will capture water from the Huaura and Checras rivers about 2 km upstream from their confluence at an altitude of 2,170 meters above sea level and It will return to the Huaura River through the discharge tunnel located about 1.5 km downstream, at an altitude of 1,548 meters above sea level.

This project is carried out in order to take advantage of the water resources of the Huaura river basin, for the generation of energy electricity with an installed power of 168 MW divided into two Pelton turbines using a head of 599 m and a design flow of 33 m^3/s. The construction of the following tunnels has been planned:

Transfer tunnel:	2,580 meters
Headrace tunnel:	9,915 m.
Powerhouse cavern:	31.5 x 15.5 x 62.7 m (high*width*length)
Tailrace tunnel:	3,700 m.
Access tunnel to the cavern:	960 m.
Adit tunnel tunnel 1:	860 m.
Surge tunnel:	697 m.

Project	Section (m^2)	Length (m)	Year	Country	Design engineering	TA.
CH La Confluencia. Túneles de Portillo y Tinguiririca	20/35.5	9.040	2009-10	Chile		•
CH La Confluencia. Lining del túnel de Portillo	35.5	11.290	2011-12	Chile	•	•
CH Itata. Pique de ataque y túnel de descarga	51	70	2013	Chile	•	•
CH Alto Maipo. Túneles de El Volcán, Suelo y Alafalfal	13/21	22.000	2013-17	Chile	•	•
CH Edrada-San Esteban	50	5.900	2010	Spain	•	
CH Belesar III. Túneles, cavernas, chimenea y pozos	45	1.650	2010-11	Spain	•	
CH Los Peares III. Túnel y pozo	45	450	2010-11	Spain	•	
CH Salas-Conchas	50	6.100	2010-11	Spain	•	
CH Chira-Soria. Caverna de Casa de Máquinas	22	60	2012	Spain	•	
CH Chira-Soria. Túneles, pozo, y cavernas	22	5.200	2015-16	Spain	•	
Proyecto hidroeléctrico ALCÁNTARA 2	75	2x700	2020-21	Spain	•	
CH Cheves. Túneles y caverna	16/41	15.776	2010-14	Peru	•	•
CH La Virgen. Túnel de conducción	18	4.600	2011	Peru	•	
CH Colca. Túneles de conducción	10	545+1.945	2016	Peru	•	
CH Manta. Túnel de conducción	10	1.800	2016-19	Peru	•	•
CH Larreynaga. Túnel de conducción y chimenea	17	2.500	2009-10	Nicaragua	•	
CH Torito. Túneles de conducción y carga	40	3.700	2011	Costa Rica	•	•
CH Los Negros. Túnel de conducción	12	3.000	2016-17	Costa Rica		•
CH Minas San Francisco. Túneles, chimenea, pozos y cavernas	50/90	1.270+350	2012-16	Ecuador	•	•
CH Renace 2. Túnel 1, 2 y desarenador	21	8.200	2012-14	Guatemala	•	•
CH Renace 3. Túnel de conducción y pozo	21	4.750	2014-15	Guatemala	•	•
CH El Recreo. Túnel de conducción	15	1.800	2014-15	Guatemala		•
Proyectos Hidroeléctricos PH-3 y Cuetzalín	10	1.180+1.280	2014	Mexico	•	
Proyecto Hidroeléctrico Tatatila	22	1.360	2014-15	Mexico	•	
CH Banda Azul	12/24	7.500+6.800	2015-16	Bolivia	•	

Cobre Las Cruces open pit Mine, Spain

Cobre Las Cruces mine aims to exploit the secondary copper ore reserves from a mineralization of massive sulfides embedded in volcanic and sedimentary rocks of the Paleozoic, hidden under tertiary sediments.

Secondary copper ore reserves have been estimated at 17,625,000 tons of ore grading 6.22% copper, with a total of 1,096,275 tons of extractable copper and 978,504 tons of recoverable copper, and marketed in the form of copper cathodes.

The coating is made up of about 140 m of marl from the Tertiary, under which a layer of sandstones, calcarenites and conglomerates with a variable thickness of 5 to 10 m, which constitutes the Niebla-Posadas aquifer. The deposit is exploited using the open-pit method of cutting, which will allow the extraction of 97% of the copper metal contained in the reserves. The final cut will be oval in shape, 1,500 m long in an east-west direction, 900 m wide in a north-south direction and a maximum depth of 245 m.

SUBTERRA is responsible for the geotechnical monitoring of the exploitation from inception to date, including both the open pit mine and the dumps. This includes mapping, stability calculations, and geotechnical monitoring.

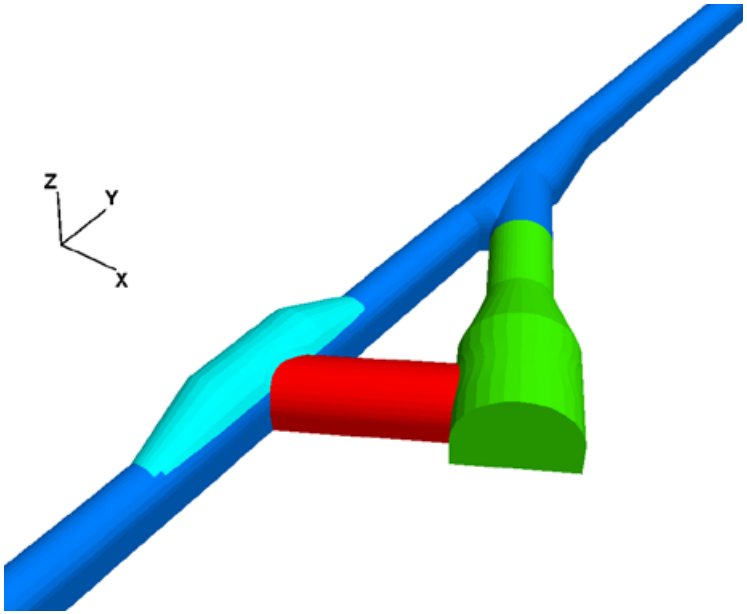
Antamina Mine. PCS and Waste Tunnels, Peru

ANTAMINA is developing the Mineral and Dismantling Tunnels project, as part of the new Crushing and Transport system (CCS & DBN).

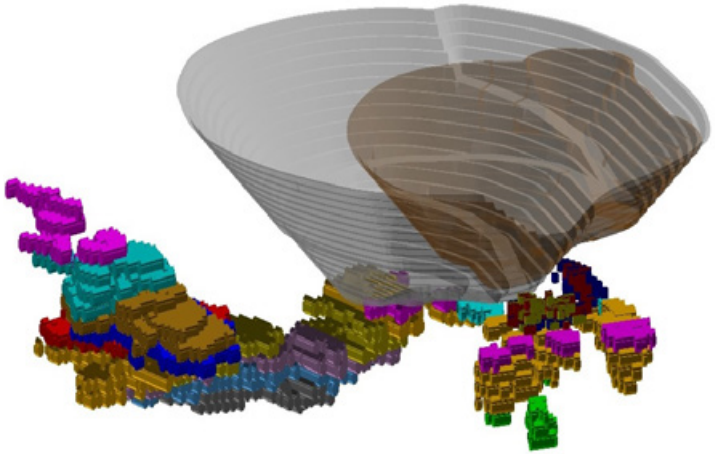
The length of the tunnels that run approximately parallel is about 3,600 m with a slope of 7.9%, having a section of about 35 m^2.

The project includes a 900 m construction window and several interconnection galleries between the two tunnels.

Project	Section (m^2)	Length (m)	Year	Country	Design engineering	TA.
Mina Los Bronces. Túnel Sur	20	8125	2010	Chile		•
Mina Collahuasi. Túnel Rosario Oeste	16	1150	2011	Chile		•
PM Chuquicamata Subterránea. Túneles Acceso y Transporte	70	7.600+6.300	2013-17	Chile		•
PM Túneles de ventilación T14 y T15	52	1400+4300+4700	2021-22	Chile	•	
Túnel de conexión Dolores	55	213	2021	Chile		•
Mina Quebradona. TAP Nivel 2	9	5700	2019-20	Colombia		•
Mina Muga. Rampas de Acceso y Transporte	50	2x2.500	2015-22	Spain	•	
Mina Cabanasas. Rampa de Transporte	50	4500	2015-20	Spain	•	•
Mina Las Cruces. Rampa y galería de investigación	35	1200	2016-18	Spain	•	•
Mina Toquepala. Túneles de transporte	32/25	2027	2011-13	Peru	•	•
Mina Quellaveco. Túnel de desvío del río Asana	25	6500	2016-17	Peru		•
Mina Romina. Rampa de Exploración Romina 2	22	850	2016-17	Peru	•	
Mina Antamina. Túnel de Transporte	30	2600	2017	Peru	•	
Mina Coroccohuayco. Túnel de Transporte	25	7500	2017	Peru	•	
Mina Antamina. Túneles Side-Hill y Decantación	17	940+320	2018	Peru		•



PM Chuquicamata Subterráneo | CHILE | CODELCO



Coroccohuayco Mine | PERU | COMPAÑÍA MINERA ANTAPACCAY (GLENCORE)

Los Gallos Tunnel. Atizapán-Atlacomulco | MEXICO | OSSA

Clients

COMISIÓN EUROPEA	MOP CHILE	METRO DE SANTIAGO	CDTI	ADIF	AYTO. MADRID	AYTO. NAVALCARNERO	CABILDO GRAN CANARIA	FGC	DIP. FORAL GIPUZKOA	INTERSUR	PROINVERSIÓN	PROVIAS NACIONAL
IBERDROLA	GAS NATURAL FENOSA	SOCOIN	AES GENER	ELECNOR	JENNER RENEWABLES	CONVIAL SIERRA NORTE	T. PORTUARIOS CHANCAY	ABERTIS	NHIDCL	COSTANERA NORTE	GESVIAL	HOCHTIEF
ASTALDI	ACCIONA	ALDESA	PROACON	AGUA SANTA	BALZOLA	BESALCO	BROTEC	COBRA	COPASA	COPISA	COPROSA	COSAPI
CAVOSA	SACYR	COMSA	CHINA RAILWAY CONSTRUCTION	CONSTRUCTORA SAN JOSÉ	ECHEVARRIA IZQUIERDO	DRAGADOS	FCC	GEOTUNEL	INSERSA	ISOLUX CORSÁN	MINCIVIL	MIOTA ENGIL
OHL	ODINSA	OGENSA	OGMIOS	OBRAS SUBTERRÁNEAS	RUBAU	TABOADA Y RAMOS	TAPUSA	TECSA	TERRATEST	EUROHINCA	CONST. VESPUCIO ORIENTE	VINCI
ASISTECSA	CRUZ Y DÁVILA	DDQ	MAS ERRÁZURIZ	ZAÑARTU	AUX. ING. y CONTROL	APIA XXI	AYESA	CALTER	CONTROL y ESTUDIOS	CYGSA	DMT	EGIS EYSER
EUROCONSULT	FULCRUM	TPF GETINSA EUROESTUDIOS	GEOESTUDIOS	GIPIC	GRUSAMAR	GOC	HIDROPROYECTOS	ICEACSA	IGR	INGENNYA	INCISA	INZAMAC
IDOM	INIMA	INYPSA	NIPPON KOEI	PROINTEC	RESTITUBO	SAITEC	SATAI	SISTEMA	SCHLUMBERGER	TRN	URCI	VS INGENOVA
AYMA MINING	ATALAYA MINING	ASTURIANA DE ZINC	EMED TARTESSUS	COBRE LAS CRUCES	COBRE SAN RAFAEL	ICL IBERIA	GEOALCALI	MATSA	OROVALLE	IBERIAN RESOURCES	RIO NARCEA	TORO MINING
ANGLOGOLD ASHANTI	AMSAC	ANTAMINA	ANTAPACCAY	ATACAMA KOZAN	COLLAHUASI	CODELCO	COMPAÑÍA MINERA LAS BAMBAS	COMPAÑÍA MINERA MILPO	CONSORCIO MINERO HORIZONTE	GRUPO MINERO LAS CENIZAS	FRONTIER COAL	KANGRA COAL

La Confluencia Hydroelectric Power Plant. VI Región | CHILE | HOCHTIEF

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